Faculty Working Papers

THE IMPACT OF "THREE MILE ISLAND" UPON ELECTRIC UTILITIES' COST OF CAPITAL

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#643

College of Commerce and Business Administration
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Summary:

This paper examines the impact the TMI (Three Mile Island) accident had on investors' risk perceptions of utilities with nuclear generating capacity. Two methods of analysis are used to determine if the beta coefficients of utilities changed due to TMI. Both methods indicate that the beta values were similar before and after the TMI incident. The switching regression method indicates the betas for the period following TMI were not significantly different from the pre-TMI period. The beta component analysis shows that the increased variability of holding period returns for the nuclear utilities was offset by a decrease in the correlation between the utilities' returns and the market's returns.

These results tend to support capital market theory. A nuclear accident is a firm specific phenomenon, and in an efficient, well-diversified market the impact on a diversified portfolio is small.

THE IMPACT OF "THREE MILE ISLAND" UPON ELECTRIC UTILITIES' COST OF CAPITAL

The 28 March 1979 Three Mile Island (TMI) accident added a new dimension to the ongoing debate over the private and social costs and benefits of nuclear power. Utility executives commonly speculate "that the Harrisburg accident will add billions of dollars to nuclear generating costs that are already vastly higher than imagined" [8]. Some indication of TMI's "financial fallout" became apparent when General Public Utilities Corporation, which owns the stricken TMI reactor, cut its quarterly dividend and told its stockholders on 9 May 1979 that unless governmental subsidies for the accident costs were forthcoming, GPU faced bankruptcy [1]. Not surprisingly, business and investment articles on the electric utility industry immediately began presenting utility data classified by the capacity percentage represented by nuclear power.

TMI made the cost-profit-solvency dimensions of "nuclear risk" more apparent to investors and regulators. Whether the TMI incident altered the required rate of return of equity investors in electric utilities with nuclear generating capacity (hereafter nukes) is an important question. If nukes are perceived to have greater risk than utilities without nuclear generating capacity (hereafter non-nukes), then this differential should be recognized in setting regulatory allowed rates of return and in choosing among competing power generation sources.

It is the objective of this paper to examine equity investors' risk perception of nukes in such a way as to be able to comment on whether TMI changed investors perceived risk. The next section describes the

switching regression and beta component analysis techniques used to detect any TMI induced shift in the risk-return expectations of equity investors in nukes. Empirical results are presented in the third section. Implications of the study are discussed in the final section.

DETECTING A SHIFT IN EQUITY INVESTORS' RISK-RETURN EXPECTATIONS

The economic argument for nuclear power revolves around a hypothesized cost advantage when construction, maintenance, operating, and capital costs are compared over the economic lives of nuclear and fossil power sources. Implicit in this economic argument is the assumption that a utility's cost of capital will not increase if it goes "nuke" since a small change in capital costs affecting the entire capitalization could offset any construction-production economies associated with nuclear power generation. This may have been a reasonable assumption in the 1950s and early 1960s. However the debate over the social costs and benefits of nuclear power in the 1970s, escalating construction costs, and operating outages may have caused investors' perceptions of the risk-return dimension of nuclear power to change importantly in the decade of the 1970s. If these developments did not attract utility investors' attention in the 1970s, the TMI incident did.

The term "nuclear risk" emerged in the investment community's jargon following TMI. A utility's exposure to "nuclear risk" depends upon whether the utility operates nuclear generating units or has nuclear plants under construction, and the relative importance of nuclear versus fossil generating capacity. For utilities operating nuclear generating units, the risk revolves around the expensive outage time and cost of continuously

modifying existing units to "state of the art" technology. For utilities with nuclear plants under construction, the risks are construction delays and cost overruns arising from required modifications, and changing licensing conditions [15]."

GPU and other nuke stocks experienced large price declines following TMI. Figure 1 shows the weekly closing price of GPU common stock (Company 14) for the 72 week period, 16 June, 1978 to 27 October, 1979.[1] The precipitous price decline between the forty-first and forty-second weeks marks the week in which the TMI incident occurred. Inasmuch as the stock market (S & P 425 Price Index) was progressing upward from week 20 through week 69, an explanation for GPU's fifty percent price decline would appear to revolve around a change in investors' perceived risk and/or a change in expected earnings.

Figure 2 provides price data for five electric utilities which derive between 43 and 58 percent of their generation capacity from nuclear units.[2] Price data for these five nukes also show substantial price deterioration immediately following TMI. However, these firms displayed a price resiliency not apparent in the GPU price data.

When price data for all nuke and non-nuke utilities are compared over the 72 week period, the impact of TMI is not as apparent.[3] The data in Figure 3 show that other than a two month time span following TMI, the price movements of the 17 nuke and 44 non-nuke utilities appear to covary rather closely. Nuke prices declined rapidly after TMI while non-nuke prices did not. But after a 6-8 week period, nuke and non-nuke price indices appear to have resumed their pre-TMI relationship. However, the mean price differential between the two groups declined after TMI as

FIGURE 1. GPU WEEKLY CLOSING PRICE: 41 WEEKS BEFORE TMI AND 31 WEEKS AFTER TMI

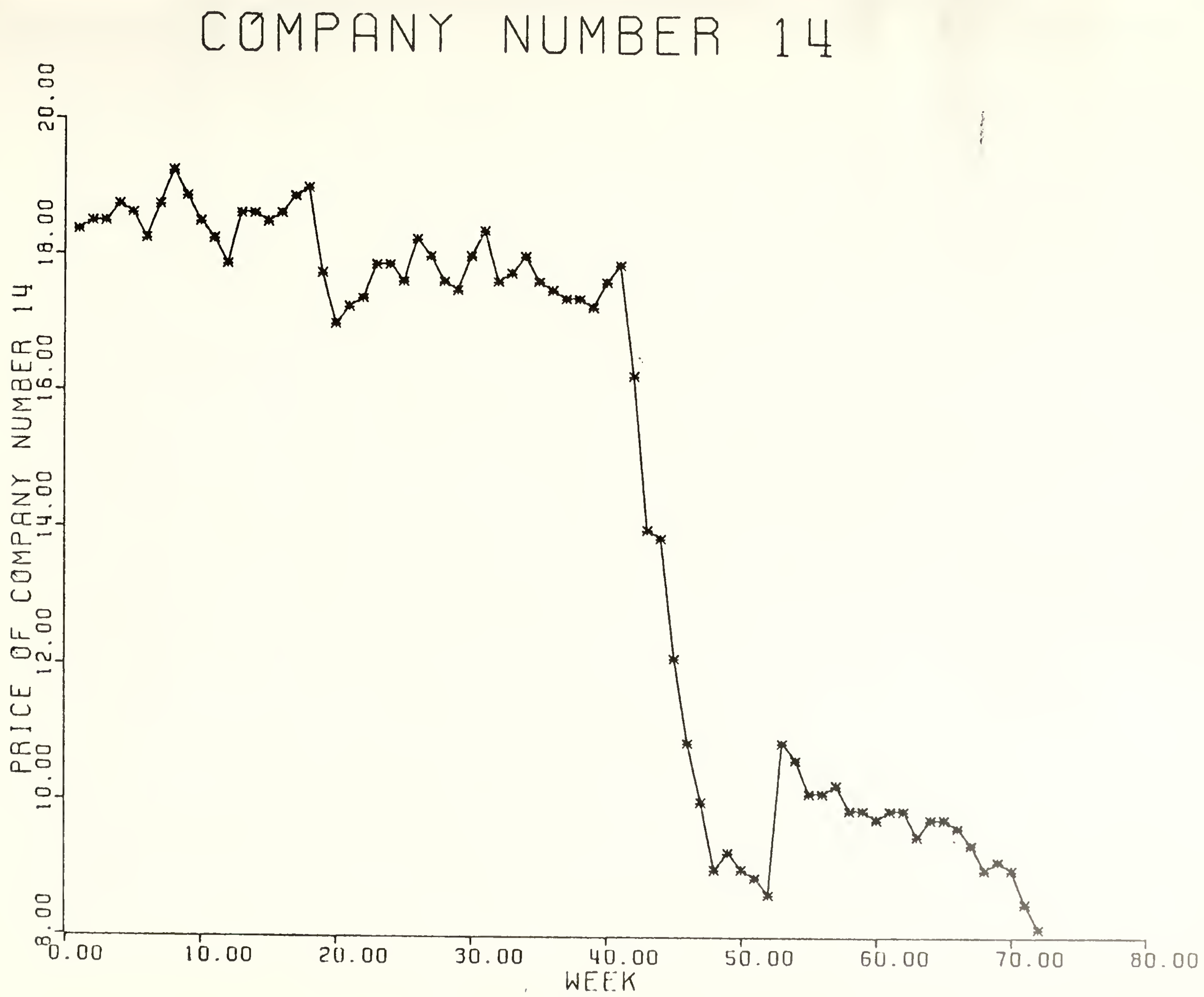


FIGURE 2. WEEKLY PRICE DATA FOR MAJOR NUKES: 41 WEEKS BEFORE TMI AND 31 WEEKS AFTER TMI

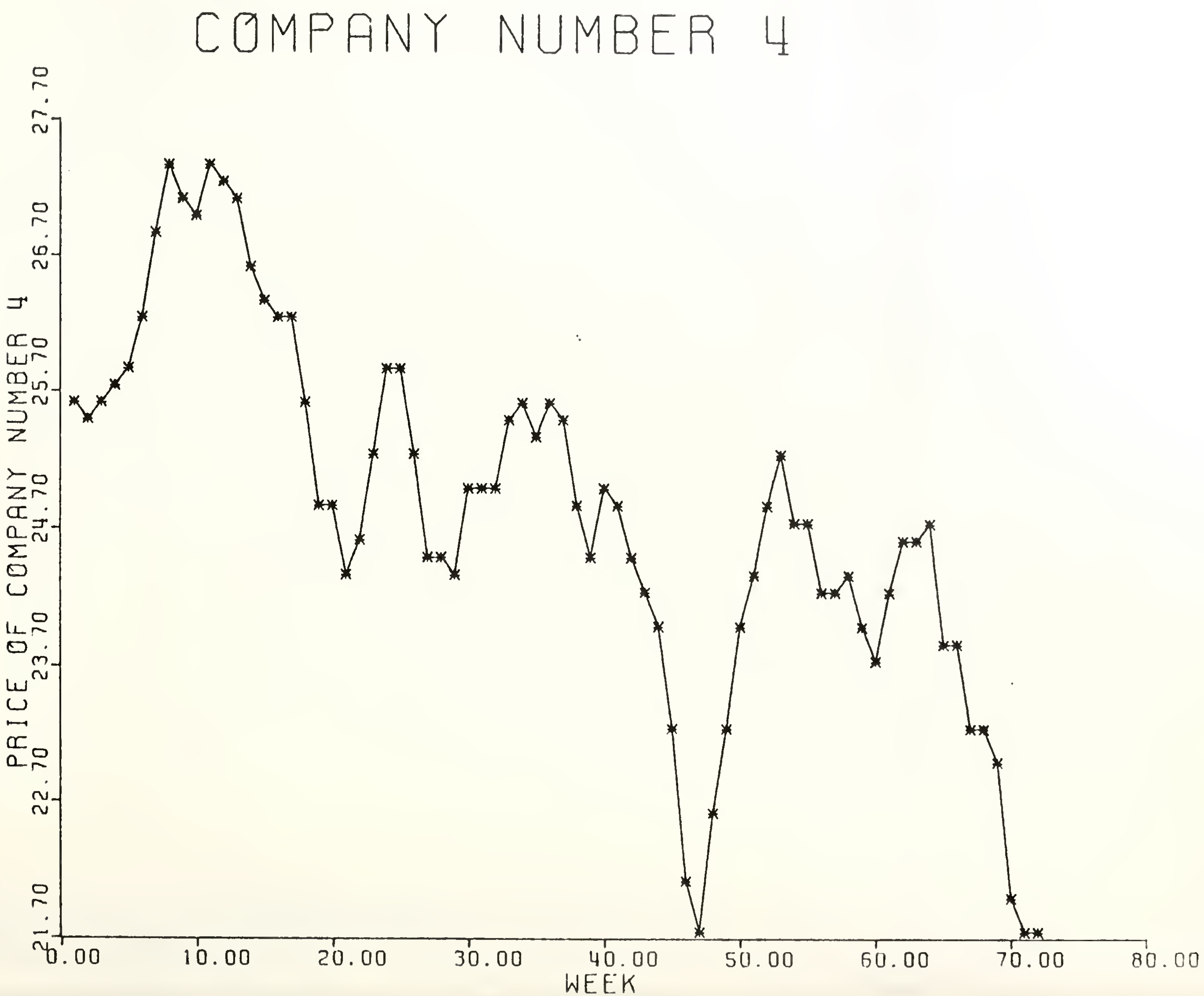


FIGURE 2. (CONTINUED)

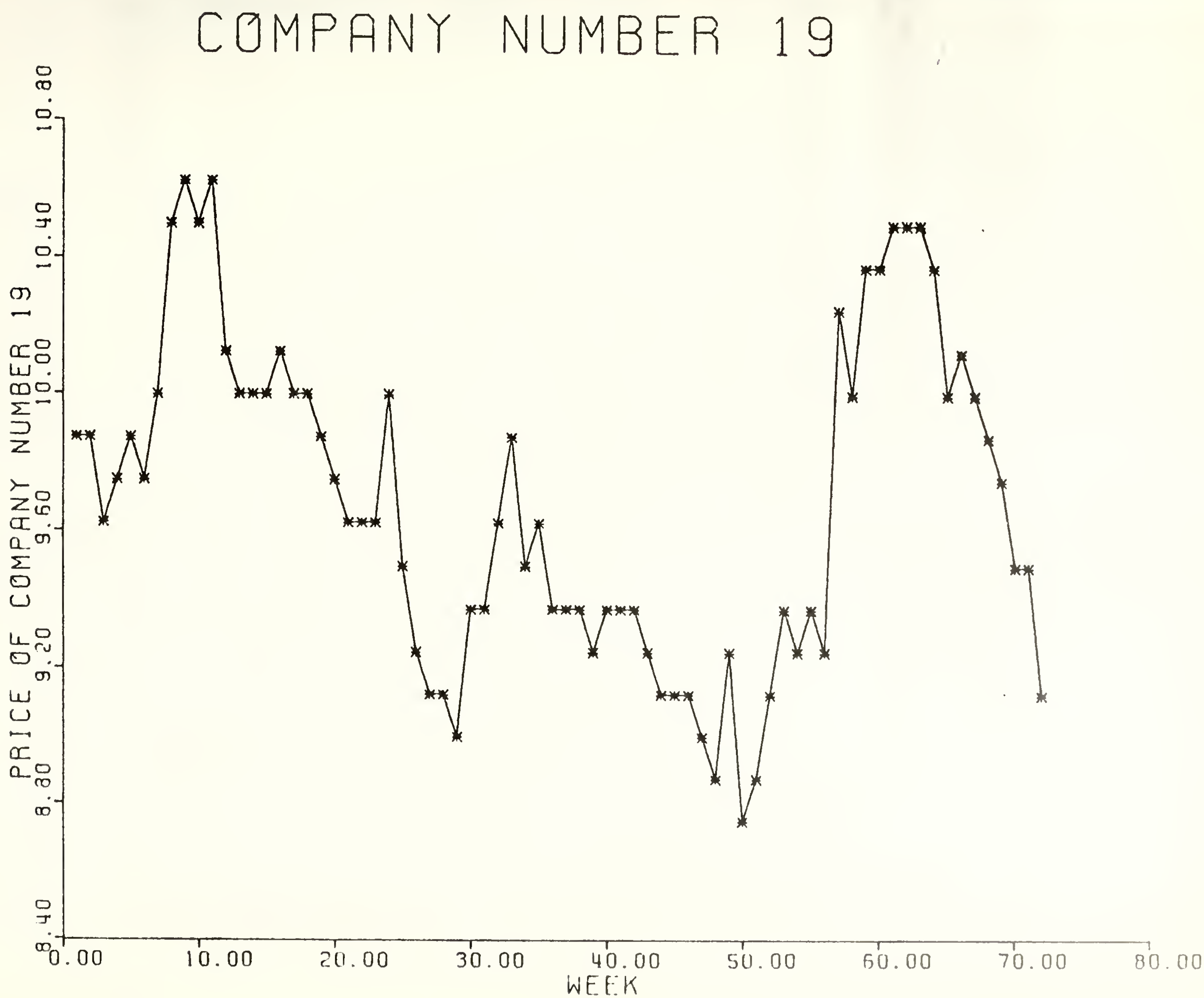


FIGURE 2. (CONTINUED)

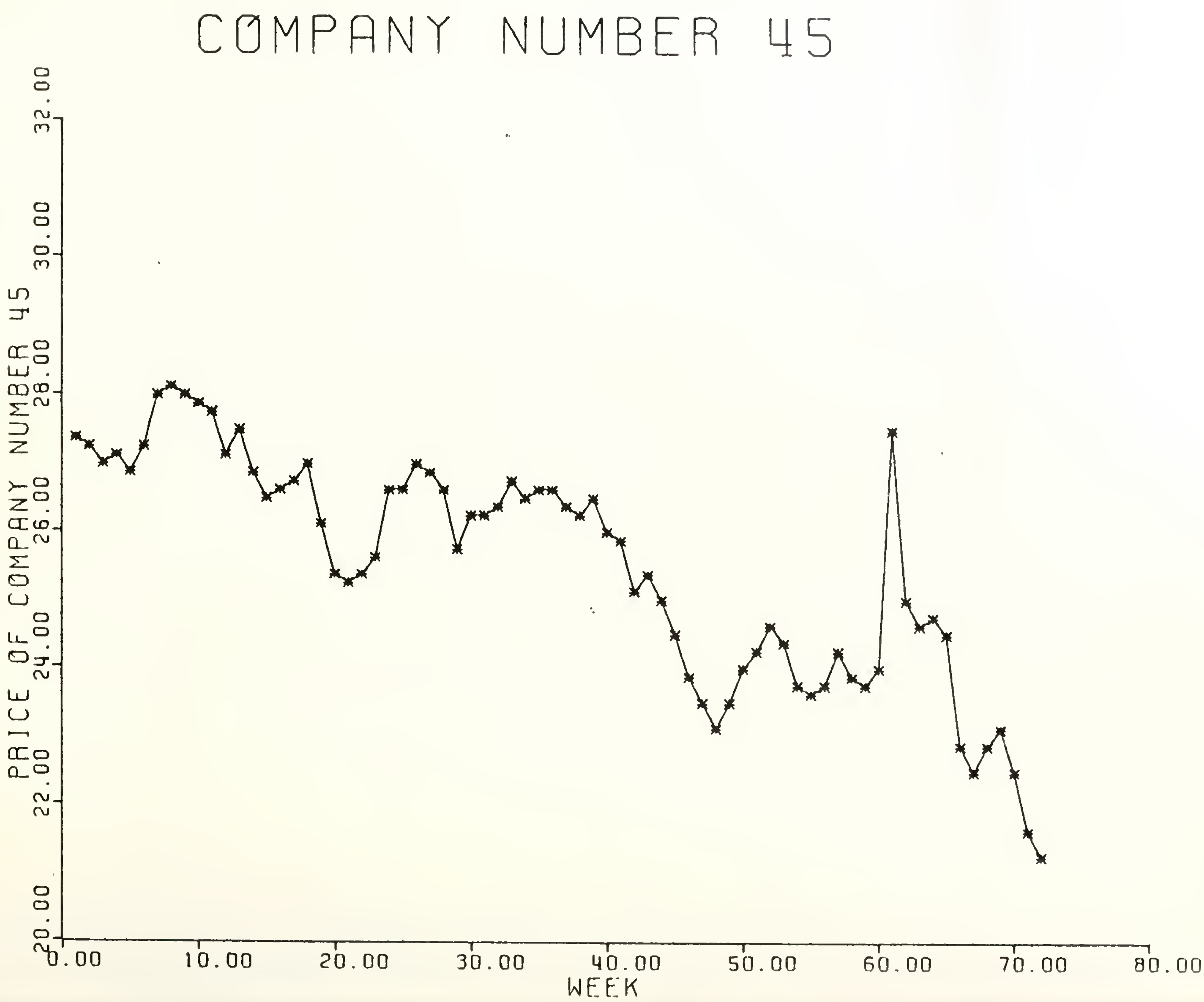


FIGURE 2. (CONTINUED)

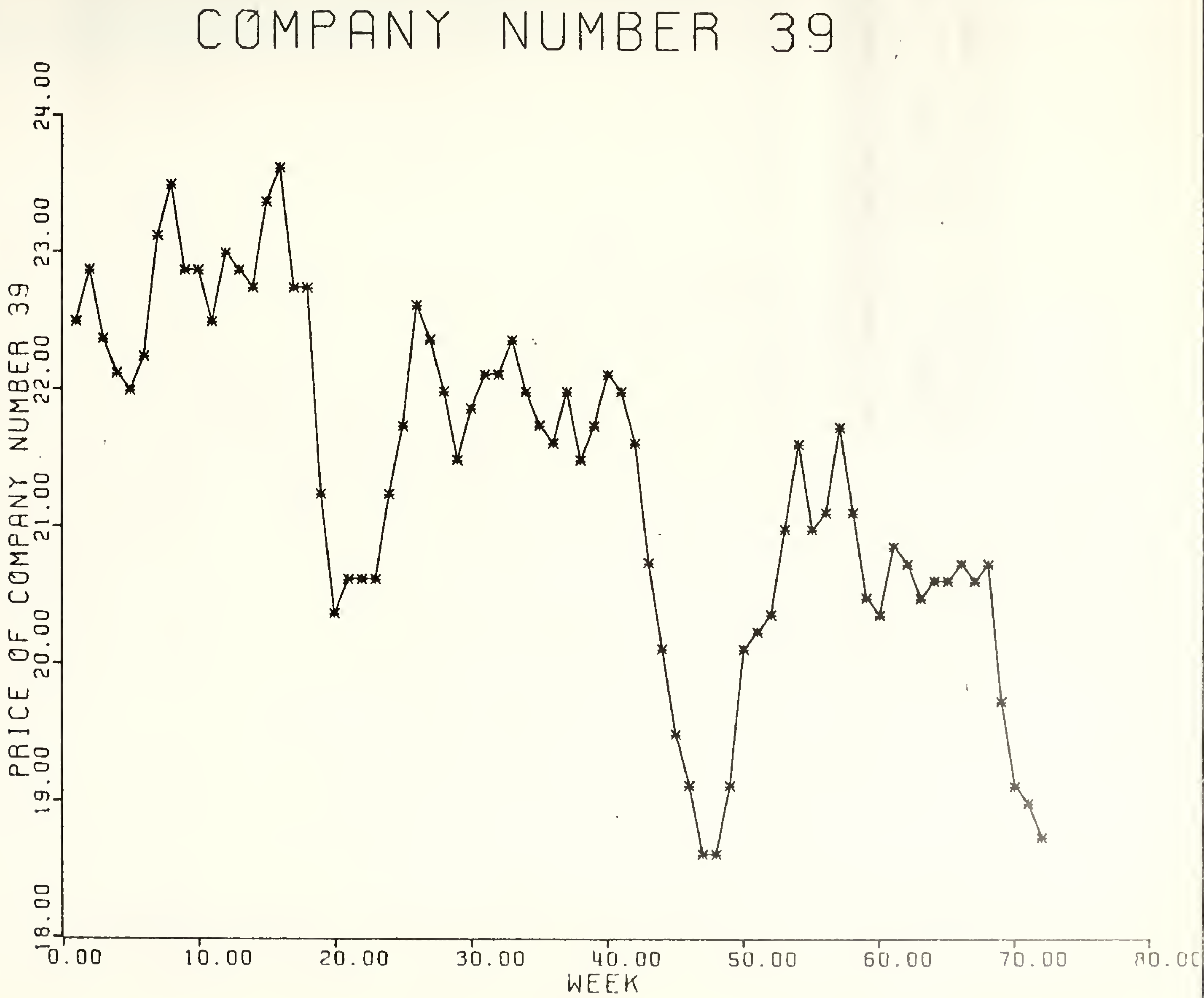


FIGURE 2. (CONTINUED)

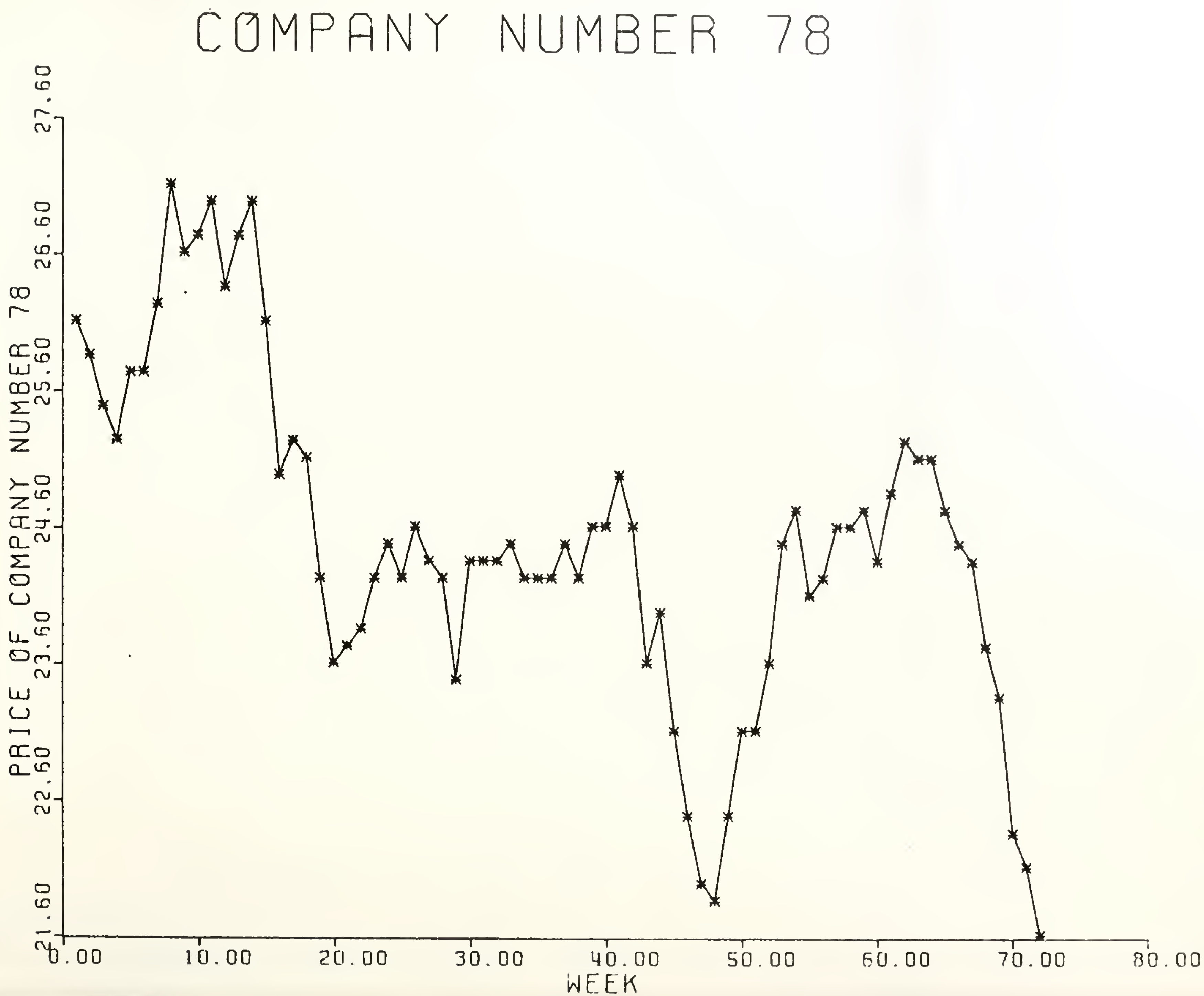
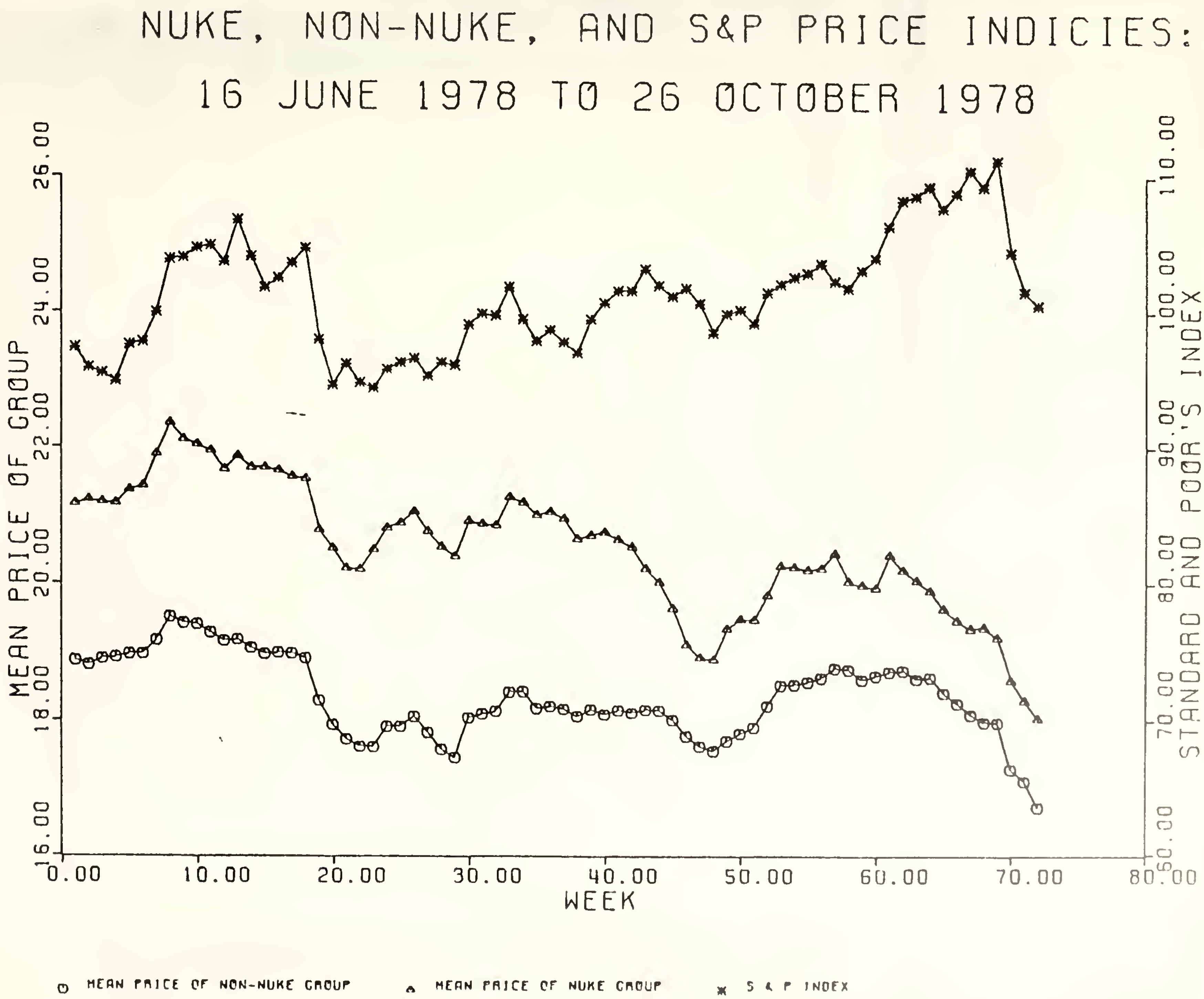


FIGURE 3


NUKE, NON-NUKE, AND S&P PRICE INDICIES:
16 JUNE 1978 TO 26 OCTOBER 1978
MEAN PRICE OF GROUP
16.00
18.00
20.00
22.00
24.00
26.00
STANDARD AND POOR'S INDEX
60.00
70.00
80.00
90.00
100.00
110.00
WEEK
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
MEAN PRICE OF NON-NUKE GROUP
MEAN PRICE OF NUKE GROUP
S & P INDEX

both sets of utilities appeared to follow general market movements less closely.

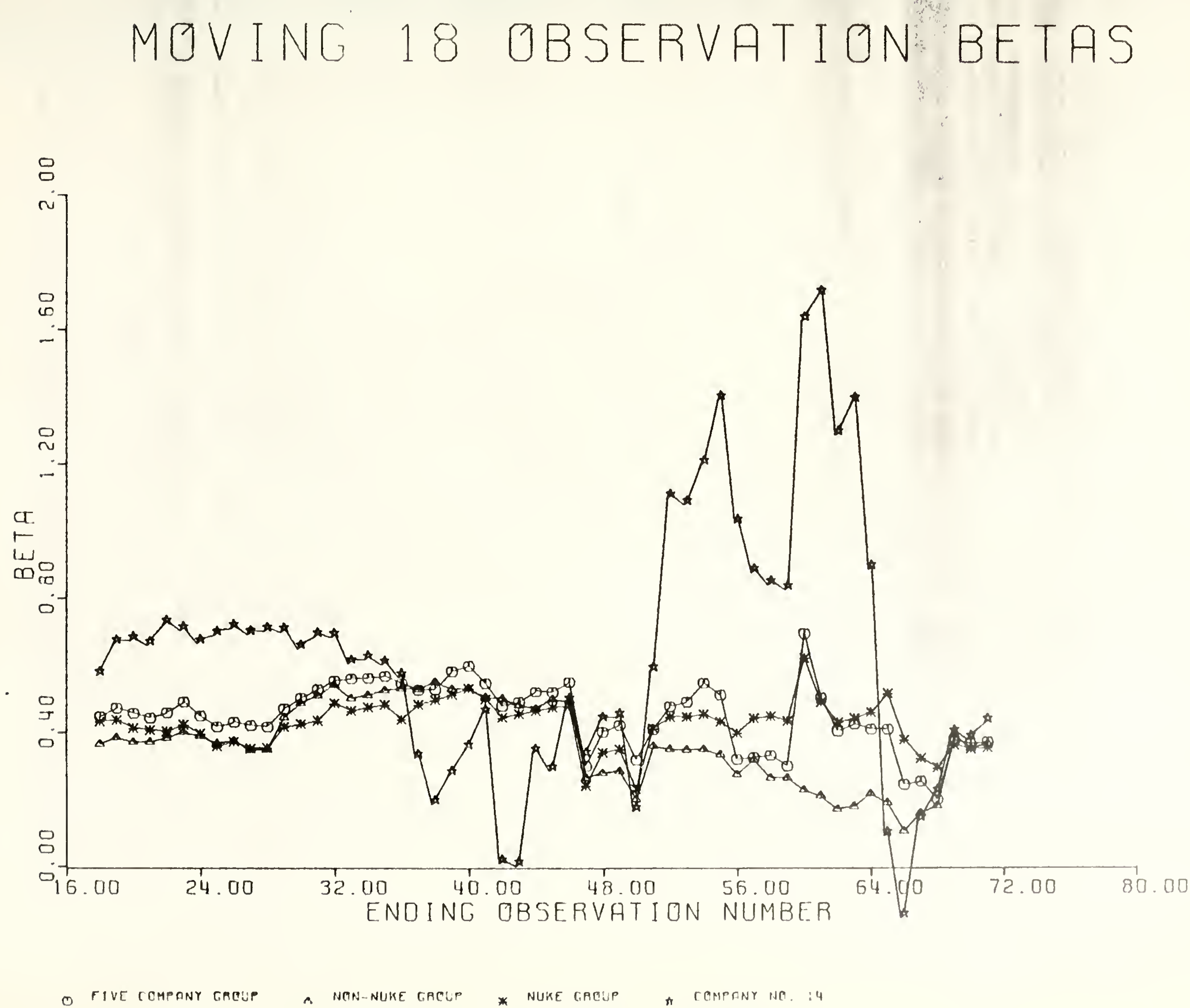
The GPU, nuke, and non-nuke price data are generally consistent with a modern portfolio theory interpretation of the TMI incident. Nuclear risk or the financial fallout of a nuclear incident such as TMI is not systematically associated with swings in the economy or the stock market. In capital market terms, nuclear risk is unsystematic risk. Since diversification in a portfolio can eliminate unsystematic risk, securities' expected returns in an efficient capital market are a function only of their systematic risk and the time value of money. Accordingly, there is no a priori logic for expecting a TMI incident to influence the perceived systematic risk of nukes and, thus, investors' required returns. This is so even though the total risk perceived by investors in nuke utilities likely increased with TMI.

Systematic risk can be measured by beta (β). β may be estimated with historical price data to determine the relative risk of a security or the required rate of return on equity using a model such as

$$\tilde{R}_{it} = \hat{\alpha}_i + \hat{\beta}_i \tilde{R}_{mkt_t} + \tilde{e}_{it} , \qquad (1)$$

where $\tilde{R}_{it}$ is the price and dividend holding period return on stock i in time t and the tilde indicates a random variable, $\tilde{R}_{mkt}$ is a market return factor common to all assets, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the parameters to be estimated, and $\tilde{e}_{it}$ is the error term in the linear model. Moving 18 week βs for weeks 18-71 are presented in Figure 4 for GPU, the 5 heavy nuclear utilities, and the nuke and non-nuke groups. The β data show little difference between the relative risk of nuke and non-nuke utilities before

FIGURE 4


MØVING 18 ØBSERVATIØN BETAS
BETA
0.00
0.40
0.80
1.20
1.60
2.00
16.00
24.00
32.00
40.00
48.00
56.00
64.00
72.00
80.00
ENDING ØBSERVATIØN NUMBER
FIVE COMPANY GROUP
NON-NUKE GROUP
NUKE GROUP
COMPANY NO. 14

TMI. Shortly after TMI, the βs of both nukes and non-nukes declined. Non-nuke βs stayed at this lower level while the βs of the nukes increased. The last three observations of the "18 week moving β plots" are based on holding period returns occurring 8-10 weeks after TMI. By the end of the analysis period, the βs of the nuke and non-nuke groups are not only again comparable to each other, but are also comparable to their pre TMI β level.

The question of interest in this study is whether the observed changes in β following TMI represented changes in the risk perceived by nuke and non-nuke investors, or were the changes due to measurement errors between "true beta" and the regression estimated beta. Two analytical methods--a dummy variable switching technique and an analysis of the components of beta--are utilitized to examine the structural stability of the β risk measures.

Switching Regression Method

A dummy variable regression method developed by Gujarati [10] was utilized to determine if and when structural changes occurred for each individual utility. This dummy variable technique which tests for the equality between two sets of regression coefficients can be expressed as

$$R_{ut} = a_0 + a_1 D + b_0 R_{mkt} + b_1 (DR_{mkt}) + e'_t \ . \qquad (2)$$

Here R_{ut} and R_{mkt} are the random returns of the electric utility index and the market index, respectively; a_0, a_1, b_0, b_1, are the regression coefficients; and e'_t is the error term. The dummy variable, D, divides the time period under consideration into two segments, thusly:

$D = 1$ if the observation (Return) is in the first, n_1, weeks of the data, and

$D = 0$ if the observation (Return) is in the second, n_2, weeks of the data.

The regression coefficients associated with the dummy variable terms represent the differential intercept, a_1, and the differential slope (beta) coefficient, respectively. The intercept value for both periods is a_0 unless a_1 is statistically significant. If a_1 is statistically significant, then the intercept value of the first n_1 months is $a_0 + a_1$ and the intercept value for the last n_2 months is a_0. Similarly, if b_1 is significant, then $b_0 + b_1$ represents the slope (beta) for the first n_1 months, and b_0 is the slope (beta) for the last n_2 months. By changing the values for n_1 and n_2, differential intercepts and slopes may be calculated over the entire time period.

This study used 71 weeks of returns data, from 16 June, 1978 through 27 October, 1979. The length of the two segments, n_1 and n_2, were changed weekly such that 48 regressions were calculated using equation (2). For example, $n_1 = 13$ weeks and $n_2 = 58$ weeks for the first regression; $n_1 = 14$ weeks and $n_2 = 57$ weeks for the second regression. The first segment, n_1, was lengthened by one week and the second segment, n_2, was shortened by one week until for the last regression $n_1 = 58$, and $n_2 = 13$. Results of the switching regression analysis are presented in the following section.

Beta Component Analysis

An analysis of the components of beta is also undertaken. The characteristic line beta can be expressed as

$$\beta = \frac{COV(\tilde{R}_{i_t}, \tilde{R}_{mkt_t})}{VAR(\tilde{R}_{mkt})} = \frac{\rho_{i,mkt}\ \sigma R_i\ \sigma R_{mkt}}{\sigma R_{mkt}^{\ 2}} - \frac{\rho_{i,mkt}\ \sigma_{ri}}{\sigma R_{mkt}} \tag{3}$$

Equation (2) reveals that estimated β varies directly with $\rho_{i,mkt}$ and σR_i, or the proportion of total return variability (risk) that is systematically associated with the market, and inversely with market variability, σR_{mkt}.

A firm's true beta measures the systematic association of $E(R_{mkt})$ and $E(R_{equil})$. Component analysis can provide insights into the dynamics of β movements. An important source of measured β instability is the use of observed holding period returns as though they are equilibrium returns. Total period return (R_T) can be imagined as being composed of an equilibrium return component and an adjustment return component or

$$R_{T_t} = R_{equil_t} + R_{adj_t}$$

where

R_{T_t} = observed holding period return;

R_{equil_t} = an equilibrium holding period return consistent with beginning of the period values for a firm's β or systematic risk and the prevailing risk-return trading terms (i.e., SML); and

R_{adj_t} = a period price adjustment return required in order for end of holding period values for $E(R_{mkt_{t+1}})$, $E(R_{T_{t+1}})$, $E(\beta_{t+1})$ to be consistent.

Observed R_T's for a firm include price adjustment returns which occur because of shifts in the prevailing trading terms for risk and return or the security market line (SML), movements along the SML (i.e., changes in the firm's systematic risk), and/or changes in a firm's expected earnings on assets. Clearly estimation bias and/or stability

problems arise because these R_{adj}'s create a discrepancy between the theoretical return construct, R_{equil}, and the observable R_T.

Consider, for example, a utility with a β of .5, a stock price of \$100 (P_0), and expected earnings and dividends per share of \$9 (D_1). If the risk free rate (R_f) is 6.0% and the expected return on the market, $E(R_{mkt})$ is 12.0%, investors expect a holding period return (R_{T_1}) of

$$R_{T_1} = \frac{P_1 - P_0 + D_1}{P_0} = \frac{\$100 - \$100 + \$9}{\$100} = 9.0\%$$

A parallel upward shift in the SML during period one due to an increase in R_f from 6.0% to 8.0% will cause R_{equil} to increase to 11.0%. The only way the \$9 expected earnings-dividends rate can provide an 11.0% return is for the price of the stock to decline to \$81.82 (\$81.82 = \$9/.11). R_T can be visualized as

$$R_{T_1} = \frac{\$81.82 - \$100 + \$9}{\$100} = R_{equil} + R_{adj}$$

$$= \quad -9.18\% \quad = 9.00\% + (-18.18\%)$$

The observed R_T of -9.18% would be treated as an equilibrium holding period return in estimating β from historical data. However, a -9.18% return for this hypothetical firm would be an equilibrium return only if the observed market return, R_{mkt}, were -26.36%.[4]

An unstable discrepancy between a firm's true beta and its regression estimated beta can arise due to the occurrence of R_{adj}'s which may cause observed R_T's to map as outliers on the firm's true characteristic line. The occurrence of R_{adj}'s due to shifts in or movements along the SML and changes in a utility's expected earnings on assets means estimation bias

rather than a structural shift in the $E(R_{equil})$ $E(R_{mkt})$ relationship may account for observed β nonstationarity after TMI. The behavior of the components of beta are examined for the nuke and non-nuke groups in an attepmt to evaluate the significance of the post TMI β instability.

EMPIRICAL RESULTS

Switching Regression Analysis

A summary of the switching regression procedure is presented in Table 1. The results for a group of 44 non-nuclear electric utilities, a group of 17 nuclear utilities, and five individual nuclear electric utilities (including GPU) are presented.

As can be seen, none of the regression coefficients, pre or post-TMI, were statistically significant for GPU. Also, the R^2 and F-ratio were low. This indicates that for this time period the market index was of little value in explaining the returns of GPU. Two of the utilities (#4 and #78) exhibited significant α_0 and β_0 coefficients. Since the coefficients for the post-TMI period (α_1 and β_1) were not significant, this means that the pre and post-TMI period betas are not significantly different. The F-ratios were statistically significant for both utilities and the R^2 values were .181 and .331 for #4 and #78, respectively.

The two groups of utilities exhibit highly significant α_0's, β_0's and F-ratios, and higher R^2 values. These results again indicate that no statistically significant structural changes occurred due to the TMI accident. These findings are consistent with a modern portfolio theory interpretation of the TMI incident.

Table 1: Results of a Dummy Variable Switching Regression Technique for the Three Mile Island Accident

(n_1 = 41, n_2 = 30)

Utility	α_0	$\alpha_1 D$	$\beta_0 R_{mkt}$	$\beta_1 DR_{mkt}$	R^2	F-Ratio
General Public Utilities	.397 (.800)	.044 (.070)	.583 (1.174)	-.023 (-.037)	.098	2.439
Co. #4	.554 (2.969)**	.031 (.133)	.443 (2.375)**	-.028 (-.121)	.181	4.922**
Co. #19	.632 (2.547)**	-.031 (-.100)	.370 (1.490)	.029 (.093)	.091	2.233
Co. #39	.674 (3.155)**	-.229 (-.851)	.323 (1.513)	.232 (.863)	.177	4.817**
Co. #78	.516 (3.265)**	-.097 (-.487)	.482 (3.055)**	.099 (.498)	.331	11.047**
17 Nuclear Utilities	.591 (5.719)**	-.013 (-.098)	.407 (3.940)**	.015 (.118)	.407	15.328**
44 Non-Nuclear Utilities	.606 (7.204)**	-.016 (-.154)	.393 (4.669)**	.017 (.164)	.485	21.041**

Note: t-values are presented in parentheses.

* indicates significance at the .05 level.
** indicates significance at the .01 level.

β Component Analysis

Beta is useful in making qualitative risk comparisons [Myers, 1978]. Modern portfolio theory assesses the risk of any security by its marginal contribution to the standard deviation of returns (risk) of a portfolio. Since the returns on any well-diversified portfolio are highly correlated with the market portfolio, a market portfolio is used to proxy investors' actual portfolios, and β is expressed $[(\rho R_{mkt}, R_T)(\sigma R_T)]/\sigma R_{mkt}$ as in equation (3).

Component values for the above three determinants of beta are shown in Table 2 for the 40 week pre-TMI and the 31 week post-TMI periods for the nuke and the non-nuke utility groups. The nukes and non-nukes displayed virtually identical $\rho_{i,mkt}$, σ_i, and, thus, β values before TMI. The non-nuke total risk proxy, σ_{non}, did not change after TMI, but the systematic association of non-nuke returns and the market fell off somewhat. Market variability declined in the post-TMI period enough that the non-nuke beta increased in spite of the lower post TMI covariance. Nukes' beta did not change even though return variability, σ_{nuke}, rose from .0116 to .0134. The declines in $\rho_{mkt,nuke}$ and σ_{mkt} offset completely the σ_{nuke} increase. It should be noted, however, that none of the changes in the various components were statistically significant.

Component values for GPU and the five utilities with 43-58 percent nuclear capacity are also presented in Table 2. GPU's beta did not change. However, the pre and post-TMI estimates of $\rho_{GPU,mkt}$ and σ_{GPU} were significantly different. GPU's beta did not change in spite of higher total risk (σ_{GPU}) in the post-TMI period because a smaller proportion of this return variability was systematically associated with the market portfolio's returns. Component data for the five utilities

Table 2: Component Values in βs of Nukes and Non-Nukes In The 41 Week Pre-TMI and 31 Week Post-TMI Periods

	(1)		(2)		(3)		(4)		(5)	
	$\rho_{i,mkt}$		σ_i		$[\rho_{i,mkt}\ \sigma_i]$		$\beta = (3)/\sigma_{mkt}$		Mean Return	
	Before TMI	After TMI	Before TMI	After TMI	Before TMI	After TMI	Before TMI	After TMI	Before TMI	After TMI
Nukes	.7219	.5251	.0116	.0134	.0084	.0070	.4229	.4067	1.00112	.99788
Non-Nukes	.7339	.6353	.0111	.0107	.0081	.0068	.4114	.4709	1.00090	.99926
GPU (#14)	.5670	.1470	.0196	.0686	.0111	.0101	.5612	.5829	1.00135	.97952
5 Nuke Group	.7399	.4061	.0128	.0182	.0095	.0074	.4783	.4272	1.00085	.998195
#45	.6378	.2406	.0135	.0374	.0086	.0090	.4349	.5201	1.00047	.99603
#4	.5500	.3256	.0149	.0235	.0082	.0077	.4139	.4423	1.00102	.99751
#19	.3924	.2223	.0202	.0288	.0079	.0064	.4003	.3701	1.00085	1.00224
#39	.5281	.2409	.0208	.0232	.0110	.0056	.5548	.3231	1.00126	.99745
#78	.7168	.4141	.0161	.0201	.0115	.0083	.5829	.4811	1.00065	.99774
S&P 425	1.000	1.000	.0198	.0173	.0198	.0173	1.000	1.000	1.00125	.99983

with the largest nuclear generation capacity show a reaction by investors to TMI that was not as severe as with GPU, but more severe than for nukes in general. Total risk increased substantially but a much smaller share of the increased variability of the return distribution was systematically associated with the returns of investors' portfolios. Thus, total risk did not change importantly for this group.

Component values of nuke and non-nuke betas were also looked at using 54 successive 18 week observation periods. Beta component data for non-nukes, nukes, the 5 utility nuke group, and GPU are plotted in Figure 5-8, respectively. These moving 18 observation data are generally consistent with the pre and post-TMI data examined above. More specifically, the level of $\rho_{i,mkt}$ and σ_i values in the pre-TMI period (weeks 1-41) and the post-TMI period (weeks 42-72) show the same general magnitude.

The data for non-nukes in Figure 5 show no evidence of any changes in the underlying beta determination process. The proxy for non-nuke total risk, σ_{non} or the standard deviation of the weekly holding period returns remains fairly constant and always below σ_{mkt}. This is in contrast to the nuke data. The nuke total risk proxy, σ_{nuke}, parallels the non-nuke risk proxy both in level and movement in the pre-TMI period. However, following TMI the σ_{nuke} estimate increases and exceeds σ_{mkt} throughout most of the post-TMI period. Noteworthy, σ_{non} and σ_{nuke} re-established their equality of the pre-TMI period in the last three "moving 18 observation periods."

Neither the nukes nor the non-nukes experienced a detectable shift in risk because of offsetting movements in $\rho_{i,mkt}$ and σ_{mkt}. State differently,

FIGURE 5

MØVING 18 ØBSERVATIØN DATA BASE FØR NØN-NUKE GRØUP

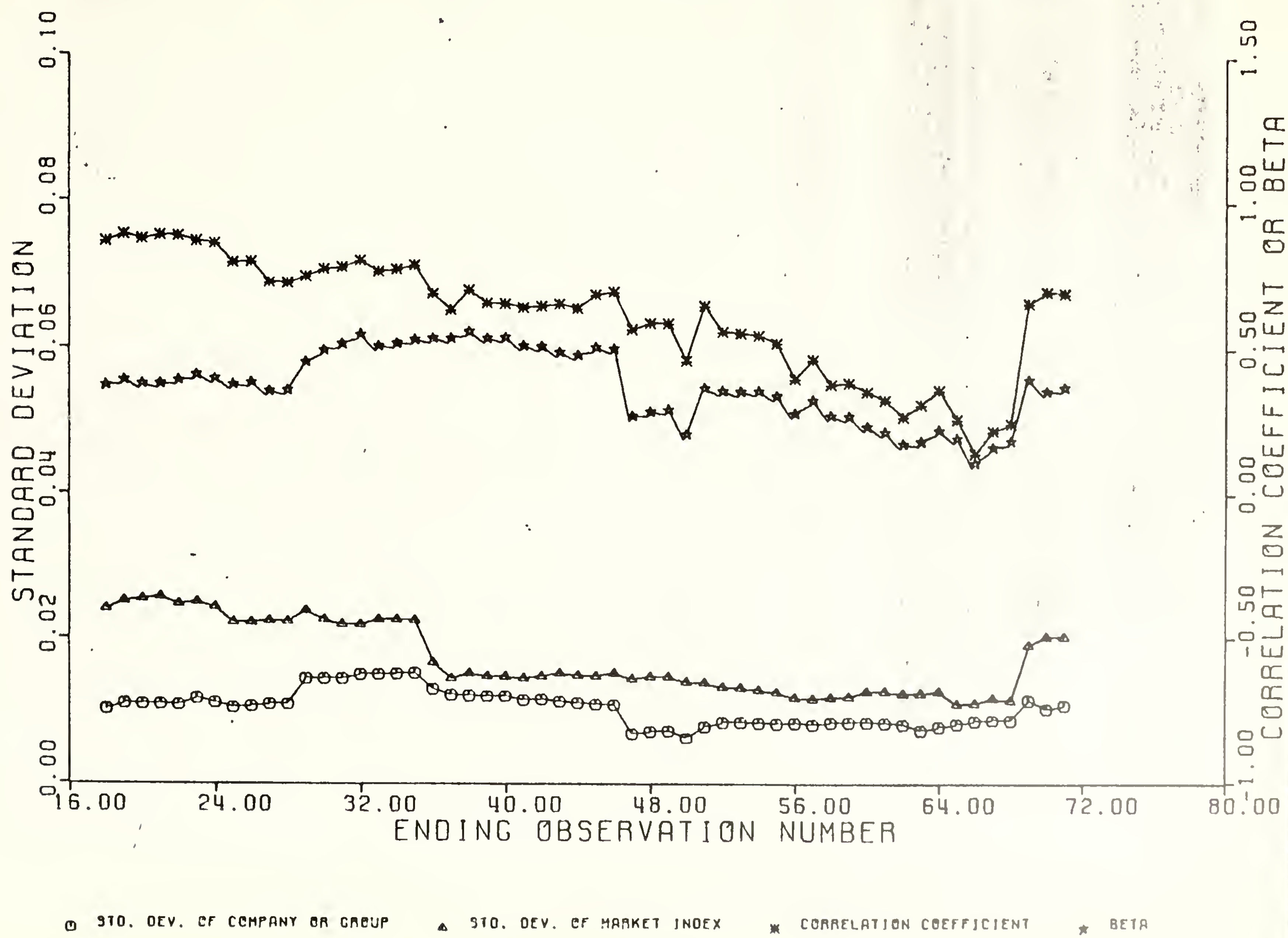


FIGURE 6

MOVING 18 OBSERVATION DATA BASE FOR NUKE GROUP

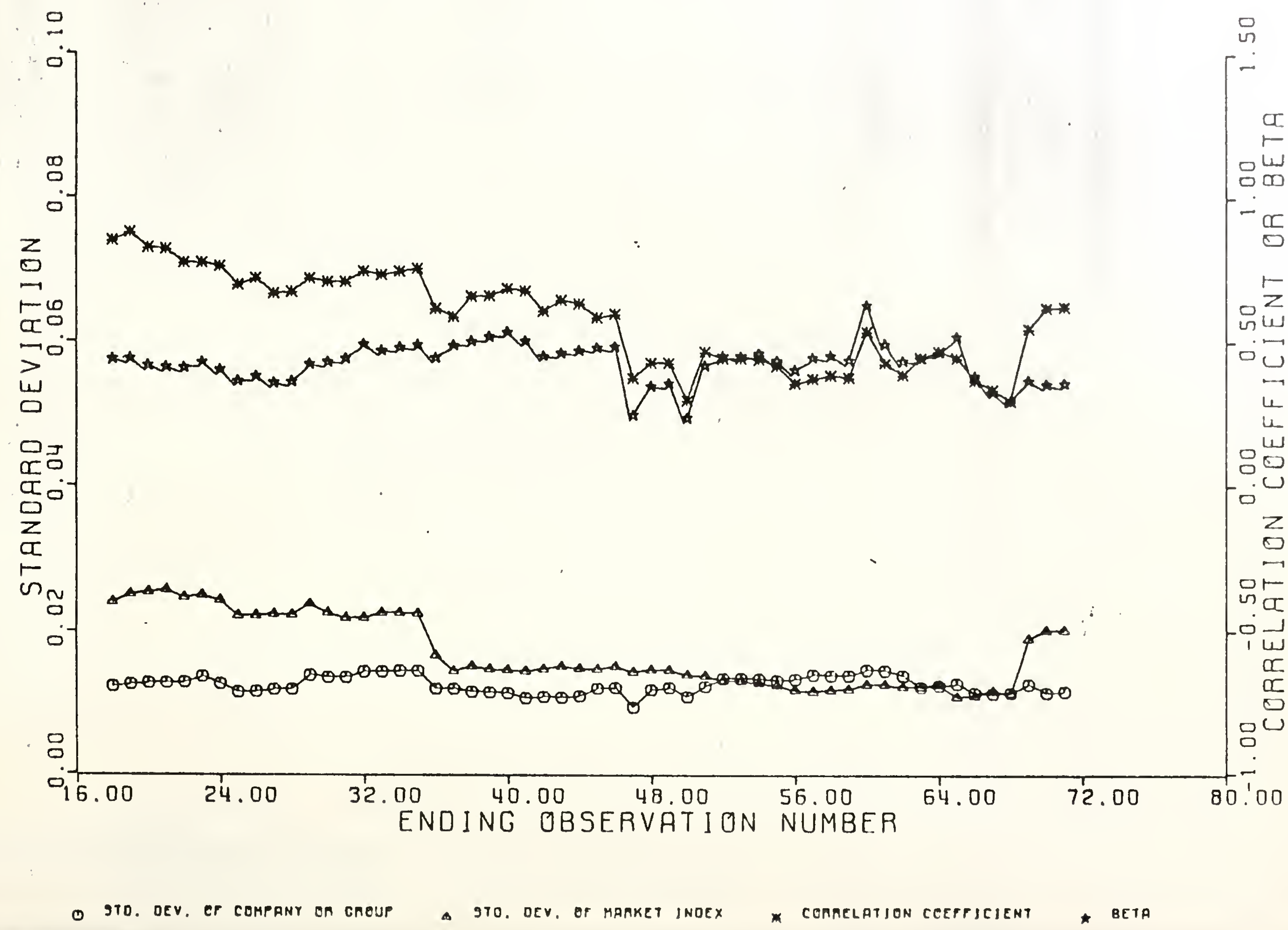


FIGURE 7

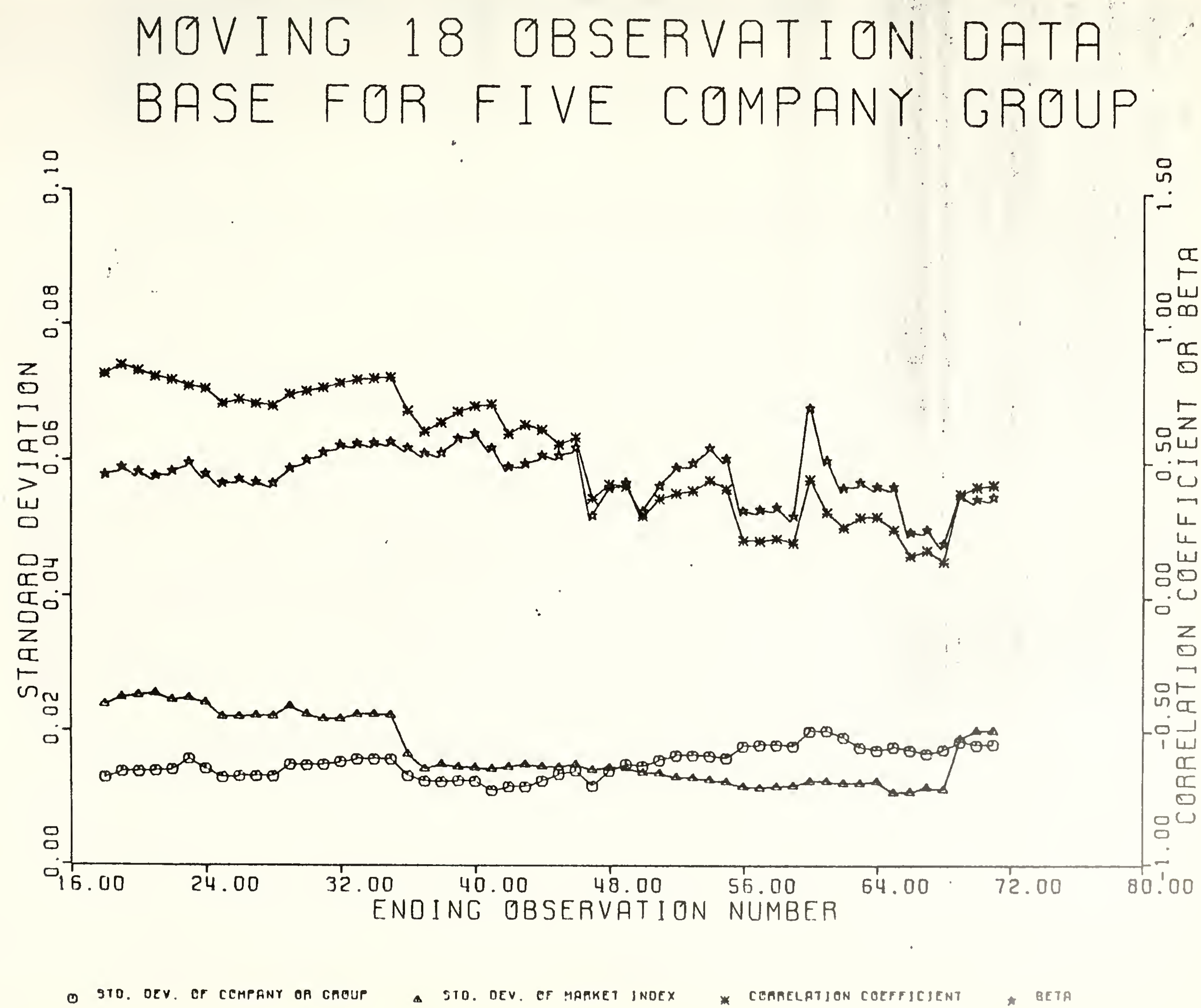
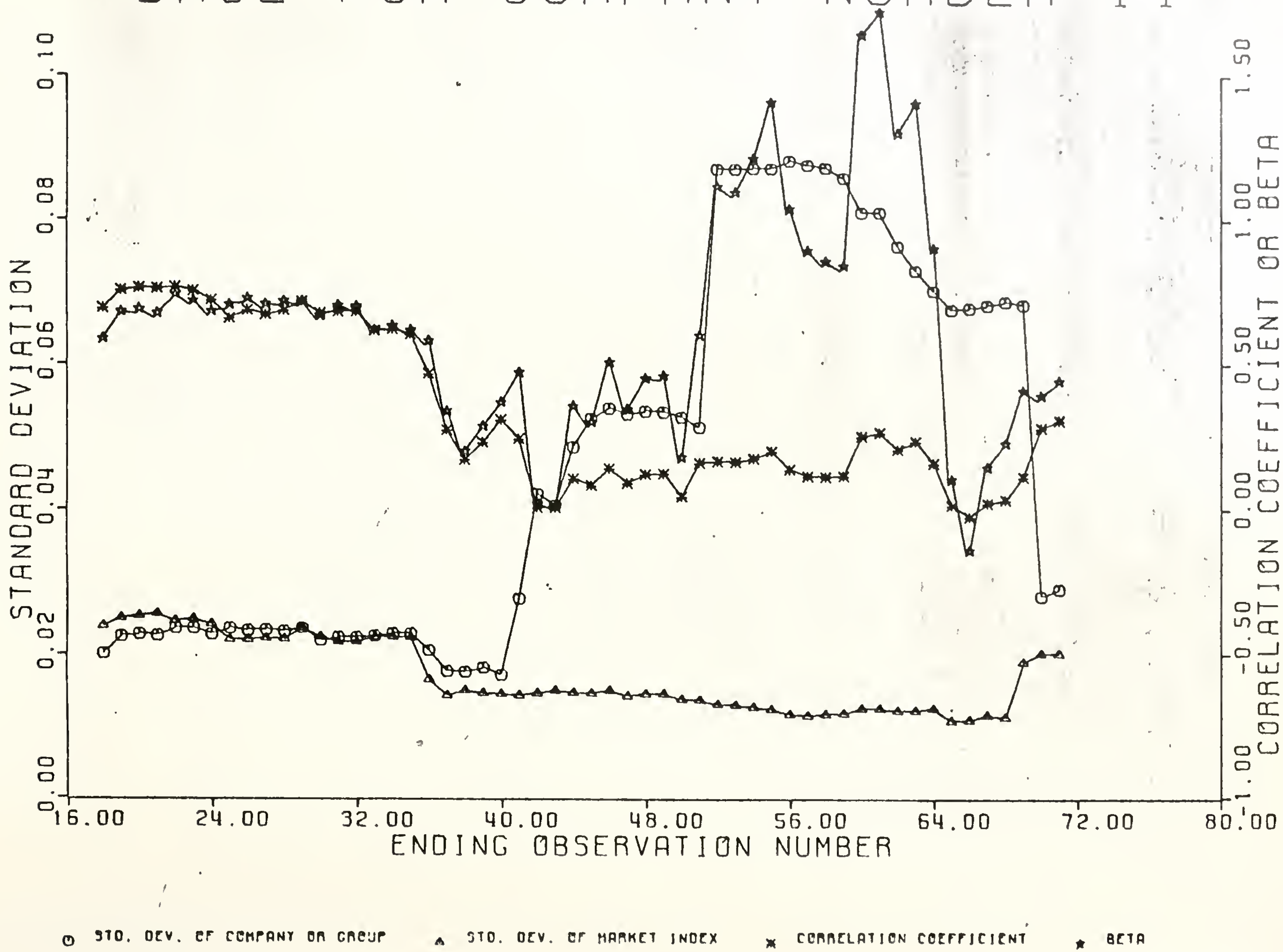

MOVING 18 OBSERVATION DATA
BASE FOR FIVE COMPANY GROUP
STANDARD DEVIATION
0.00
0.02
0.04
0.06
0.08
0.10
CORRELATION COEFFICIENT OR BETA
-1.00
-0.50
0.00
0.50
1.00
1.50
16.00
24.00
32.00
40.00
48.00
56.00
64.00
72.00
80.00
ENDING OBSERVATION NUMBER
STD. DEV. OF COMPANY OR GROUP
STD. DEV. OF MARKET INDEX
CORRELATION COEFFICIENT
BETA

FIGURE 8

MOVING 18 OBSERVATION DATA BASE FOR COMPANY NUMBER 14



while the nuke total risk measure (σ_{nuke}) increased, the proportion of that risk that could be associated with the risk of the market portfolio (systematic risk) declined. As a result β changed little after TMI just as modern portfolio theory suggests.

The observed increase in the standard deviation of weekly holding period returns (σ_i) and decrease in $\rho_{i,mkt}$ has practical appeal. Most financial press stories on nuclear generation following TMI stressed the added costs nuke utilities would encounter in the indefinite future through constant retrofitting of their nuclear units to state-of-the-art technology. To the extent investors reduced their earnings return expectations for nuke utilities, substantial negative price adjustment returns (R_{adj}'s) would occur. Conceptually, beta measures the systematic association of R_{mkt} and R_{equil}. A beta estimation problem arises when the equilibrium returns, R_{equil}, are proxied by holding period returns (R_T's) dominated by price adjustment returns (R_{adj}'s).

The use of total returns, R_T's, in the estimation of beta which embody adjustment returns, R_{adj}'s, due to revised earnings expectations could cause observed changes in σ_i and $\rho_{i,mkt}$ to be different than σR_{equil} and $\rho R_{equil}, R_{mkt}$ which are fundamentally unobservable. An explanation for post-TMI nuke prices based on a change in investors' expected earnings is equivalent to hypothesizing $\beta_{Pre\ TMI} = \beta_{Post\ TMI}$ or no change in risk. The data for GPU and the five nuke firms with 43-58 percent nuclear capacity are not inconsistent with this hypothesis.

Figure 7 data for the five nukes correspond closely with the total nuke group data. The increase in the total risk measure is greater than for all nukes as would be expected since these five firms have the

largest nuclear capacity and, thus, the highest increased cost exposure. GPU's total risk proxy increases dramatically following TMI because of price adjustment returns (R_{adj}'s) in the weekly holding period returns (R_T's). Gilster and Linke [9] have shown that estimated betas may first decline and then rise as GPU's estimated beta did following TMI. It is noteworthy that GPU's beta and $\sigma_{R_{GPU}}$ had resumed pre-TMI levels by the last three "moving 18 month observations." A ready explanation for this is that the large price adjustment returns (R_{adj}'s) embodied in the R_T's occurred within the first 6-8 weeks following TMI, and were not important elements in the total returns of weeks 50-71. This explanation has the twin advantages of being consistent with modern capital market theory and common sense.

CONCLUDING OBSERVATIONS

This paper has examined the impact the TMI accident had on investors' risk perceptions of utilities with nuclear generating capacity. Two methods of analysis were used to determine if the beta coefficients of utilities changed due to TMI. Both methods indicate that the beta values were similar before and after the TMI incident. The switching regression method indicated the betas for the period following TMI were not significantly different from the pre-TMI period. The beta component analysis showed that the increased variability of holding period returns for the nuclear utilities was offset by a decrease in the correlation between the utilities' returns and the market's returns.

These results tend to support capital market theory. A nuclear accident is a firm specific phenomenon, and in an efficient, well-diversified market the impact on a diversified portfolio is small.

FOOTNOTES

[1]Weekly price and dividend data for the electric utilities and weekly price data for the S&P 425 Index were obtained from ISL and Barrons.

[2]The five utilities and their respective nuclear capacity percentages are: Northeast Utilities 58%; Baltimore Gas & Electric, 57%; Carolina Power & Light, 47%; Commonwealth Edison, 45%; and Northern States Power, 43%.

[3]The electric utilities of the CRISP Tapes were classified using data contained in [22,23] into five nuclear generation categories as of April 1, 1978: (1) operating nuclear units alone; (2) operating nuclear units jointly with other utilities; (3) building nuclear units alone; (4) building nuclear units jointly; and (5) no nuclear generation ownership. A utility that both operated its own nuclear unit as well as operated units jointly was classified in category 1. In this study "nukes" is used to refer to category 1 firms and "non-nukes" to refer to category 5 firms.

[4]$-9.18\% = R_f + \beta(R_f - R_{mkt}) = 8.00\% + .5(8.00\% - R_{mkt})$ only when R_{mkt} is equal to -26.367.

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